19-0117; Rev 1; 11/94

MAXIM

High-Speed, CMOS, Quad, SPST Analog Switch

General Description

Maxim's HI-201HS is a monolithic, CMOS, quad, single-pole-single-throw (SPST), high-speed analog switch featuring fast switching times (t_{OFF}, $t_{ON} \leq 50ns$) and low on resistance (50Ω max). It is pin compatible with the industry-standard DG201A.

Maxim's new high-voltage silicon-gate technology increases the maximum supply-voltage rating to 44V. This improvement allows continuous operation with ±20V supplies, which is not permitted with the original manufacturer's devices. Maxim's HI-201HS operates from dual supplies ranging from ±5V to ±20V, or from single supplies from +12V to +20V. Logic levels are TTL-/CMOS-compatible with single or dual supplies within these ranges.

Maxim's HI-201HS is guaranteed not to latch up if power supplies are disconnected while the analog-switch inputs are present, provided the switch continuous-current ratings are not exceeded. When powered up, the HI-201HS will switch analog signals up to the power-supply rails.

Applications

Automatic Test Equipment (ATE)
Heads-Up Displays
Communication Systems
Sample-and-Hold Circuits
Military
Integrator Reset Circuits

Features

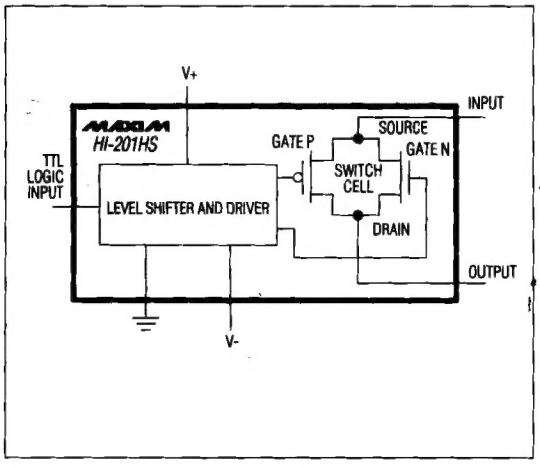
- ♦ **Guaranteed Single-Supply Operation: +12V to +20V**
- ♦ **Guaranteed Dual Supplies: ±5V to ±20V**
- ♦ **Fast Switching Times:**
  t_{ON} = 30ns
  t_{OFF} = 40ns
- ♦ **Low, 50Ω Max On Resistance**
- ♦ **TTL-/CMOS-Compatible**
- ♦ **44V Max Supply Rating**

Ordering Information

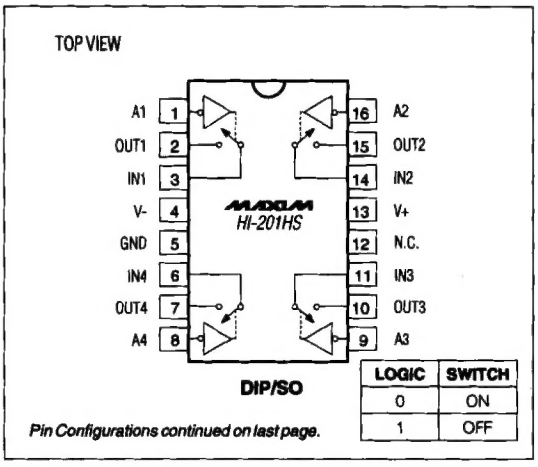
PART	TEMP. RANGE	PIN-PACKAGE
HI3-0201HS-5	0°C to +70°C	16 Plastic DIP
HI6-0201HS-5	0°C to +70°C	16 Narrow SO
HI1-0201HS-5	0°C to +70°C	16 CERDIP
HI0-0201HS-6	0°C to +70°C	Dice*
HI3-0201HS-9	-40°C to +85°C	16 Plastic DIP
HI6-0201HS-9	-40°C to +85°C	16 Narrow SO
HI1-0201HS-9	-40°C to +85°C	16 CERDIP
HI1-0201HS-2	-55°C to +125°C	16 CERDIP
HI4-0201HS-8	-55°C to +125°C	20 LCC**

** Contact factory for dice specifications.*
*** Contact factory for availability.*

Functional Diagram



Pin Configurations



LOGIC	SWITCH
0	ON
1	OFF

Pin Configurations continued on last page.

High-Speed, CMOS, Quad, SPST Analog Switch

ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-
- V+ 44V
- GND 25V

Digital Inputs V_S, V_D (Note 1) ... (V- - 4V) to (V+ + 4V) or 30mA (whichever occurs first)

Current (any terminal, except S or D) 30mA

Continuous Current, S or D 20mA

Peak Current, S or D
(pulsed at 1ms, 10% duty cycle max) 40mA

Continuous Power Dissipation (T_A = +70°C, Note 2)
- 16-Pin DIP (derate 10.53mW/°C above +70°C) 842mW
- 16-Pin Wide SO (derate 9.52mW/°C above +70°C) ... 762mW
- 16-Pin CERDIP (derate 10.00mW/°C above +70°C) .. 800mW
- 20-Pin LCC (derate 9.09mW/°C above +70°C) 727mW

Operating Temperature Ranges:
- HI-0201HS-5/-6 ..... 0°C to +70°C
- HI-0201HS-9 ..... -40°C to +85°C
- HI-0201HS-2/-8 ..... -55°C to +125°C

Storage Temperature Range ..... -65°C to +150°C

Lead Temperature (soldering, 10sec) ..... +300°C

Note 1: Signals on Sx, Dx, or INx exceeding V+ or V- are clamped by internal diodes. Limit forward current to maximum current ratings.

Note 2: All leads soldered or welded to PC board.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V+ = 15V, V- = -15V, GND = 0V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		HI-201HS-2/-8 MIN (Note 3)	HI-201HS-2/-8 TYP (Note 4)	HI-201HS-2/-8 MAX	HI-201HS-5/-6/-9 MIN (Note 3)	HI-201HS-5/-6/-9 TYP (Note 4)	HI-201HS-5/-6/-9 MAX	UNITS
SWITCH										
Analog-Signal Range	V_{ANALOG}			-15		15	-15		15	V
Drain-Source On Resistance (Note 5)	$r_{DS\ (on)}$	V_D = ±10V, V_{IN} = 0.8V, I_S = 1mA			30	50		30	50	Ω
Source-Off Leakage Current	$I_{S\ (off)}$	V_{IN} = 3.0V	V_S = 14V, V_D = -14V	-1	±0.01	1	-1	±0.01	1	nA
			V_S = -14V, V_D = 14V	-1	±0.02	1	-1	±0.02	1	
Drain-Off Leakage Current	$I_{D\ (off)}$	V_{IN} = 3.0V	V_D = 14V, V_S = -14V	-1	±0.01	1	-1	±0.01	1	nA
			V_D = -14V, V_S = 14V	-1	±0.02	1	-1	±0.02	1	
Drain-On Leakage Current (Note 6)	$I_{D\ (on)}$	V_D = -14V, V_{IN} = 0.8V		-1	±0.10	1	-1	±0.10	1	nA
		V_D = 14V, V_{IN} = 0.8V		-1	±0.15	1	-1	±0.15	1	
LOGIC INPUT										
Input Current with Input Voltage High	I_{INH}	V_{IN} = 3.0V		-1	0	1	-1	0	1	µA
		V_{IN} = 15V		-1	0	1	-1	0	1	
Input Current with Input Voltage Low	I_{INL}	V_{IN} = 0.8V		-1	0	1	-1	0	1	µA

ELECTRICAL CHARACTERISTICS (continued)

(V+ = 15V, V- = -15V, GND = 0V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		HI-201HS-2/-8			HI-201HS-5/-6/-9			UNITS
				MIN (Note 3)	TYP (Note 4)	MAX	MIN (Note 3)	TYP (Note 4)	MAX	
DYNAMIC										
Turn-On Time	t_{on}	Figure 6			30	50		30	50	ns
Turn-Off Time	t_{off}	Figure 6			40	50		40	50	ns
	t_{off2}				150			150		
Output Settling Time					180			180		ns
Charge Injection	Q	C_L = 1000pF, V_{GEN} = 0V, R_{GEN} = 0Ω			10			10		pC
Source-Off Capacitance	$C_{S\ (off)}$	V_S = 0V, V_{IN} = 5V	f = 140kHz		10			10		pF
Drain-Off Capacitance	$C_{D\ (off)}$	V_S = 0V, V_{IN} = 5V	f = 140kHz		10			10		pF
Channel-On Capacitance	$C_{D\ (on)}$ + $C_{S\ (on)}$	V_D = V_S = 0V, V_{IN} = 0V	f = 140kHz		30			30		pF
Off Isolation		V_{IN} = $3V_{RMS}$, Z_L = 1kΩ, f = 100kHz			72			72		dB
Crosstalk (Channel-to-Channel)		V_S = 2.0V, f = 100kHz			90			90		dB
SUPPLY										
Positive Supply Current	I+	All channels on or off		-3.0	3.8	6.5	-3.0	3.8	6.5	mA
Negative Supply Current	I-				1.0			1.0		mA
Power-Supply Range for Continuous Operation	V_{OP}	(Note 5)		±4.5		±20	±4.5		±20	V

High-Speed, CMOS, Quad, SPST Analog Switch

ELECTRICAL CHARACTERISTICS

(V+ = 15V, V- = -15V, GND = 0V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		HI-201HS-2/-8 MIN (Note 3)	HI-201HS-2/-8 TYP (Note 4)	HI-201HS-2/-8 MAX	HI-201HS-5/-6/-9 MIN (Note 3)	HI-201HS-5/-6/-9 TYP (Note 4)	HI-201HS-5/-6/-9 MAX	UNITS
SWITCH										
Analog-Signal Range	V_{ANALOG}			-15		15	-15		15	V
Drain-Source On Resistance (Note 5)	$r_{DS\ (on)}$	V_D = ±10V, V_{IN} = 0.8V, I_S = 1mA			75			75		Ω
Source-Off Leakage Current	$I_{S\ (off)}$	V_{IN} = 3.0V	V_S = 14V, V_D = -14V	-100		100	-50		50	nA
			V_S = -14V, V_D = 14V	-100		100	-50		50	
Drain-Off Leakage Current	$I_{D\ (off)}$	V_{IN} = 3.0V	V_D = 14V, V_S = -14V	-100		100	-50		50	nA
			V_D = -14V, V_S = 14V	-100		100	-50		50	
Drain-On Leakge Current (Note 6)	$I_{D\ (on)}$	V_D = -14V, V_{IN} = 0.8V		-100		100	-50		50	nA
		V_D = 14V, V_{IN} = 0.8V		-100		100	-50		50	
LOGIC INPUT										
Input Current with Input Voltage High	I_{INH}	V_{IN} = 3.0V		-1.0		1.0	-1.0		1.0	µA
		V_{IN} = 15V		-1.0		1.0	-1.0		1.0	
Input Current with Input Voltage Low	I_{INL}	V_{IN} = 0.8V		-1.0		1.0	-1.0		1.0	µA
DYNAMIC										
Turn-On Time	t_{on}	See Figure 6			75			75		ns
Turn-Off Time	t_{off}	See Figure 6			75			75		ns
SUPPLY										
Positive Supply Current	I+	All channels on or off			10			10		mA
Negative Supply Current	I-	All channels on or off		6			6			mA

Note 3: The algebraic convention where the most negative value is a minimum and the most positive a maximum is used in this data sheet.
Note 4: Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
Note 5: Electrical characteristics, such as on resistance, will change when power supplies other than ±15V are used.
Note 6: $I_{D(on)}$ is leakage from driver into on switch.

Protecting Against Fault Conditions

Fault conditions occur when power supplies are turned off and input signals are still present, or when overvoltages occur at the inputs during normal operation. In either case, source-to-body diodes can be forward biased and conduct current from the signal source. If this current must be kept at low (µA) levels, we recommend adding external protection diodes (Figure 1).

To provide protection for overvoltages up to 20V above the supplies, place a 1N4001 or 1N914 type diode in series with the positive and negative supplies, as shown in Figure 1. Adding these diodes will reduce the analog-signal range to 1V below the positive supply and 1V above the negative supply.

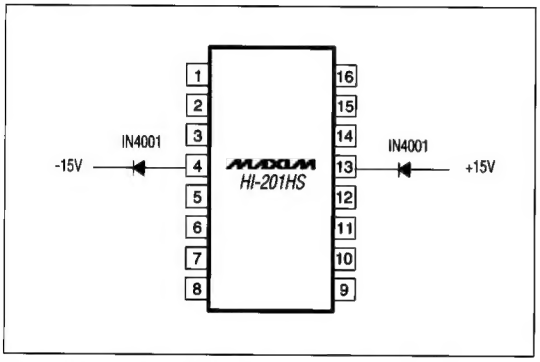


Figure 1. Protection Against Fault Conditions

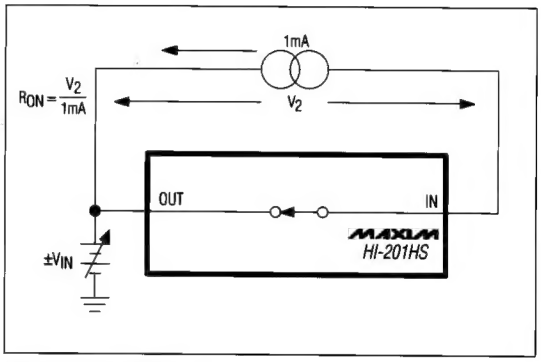


Figure 2. On Resistance

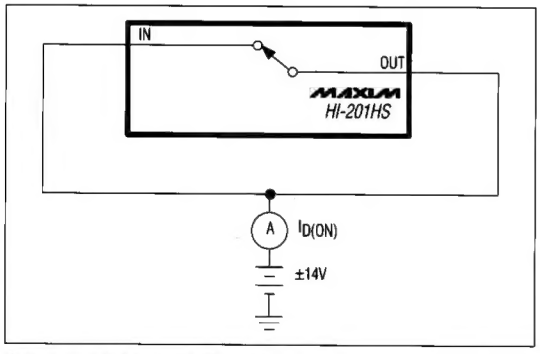


Figure 3. On Leakage Current

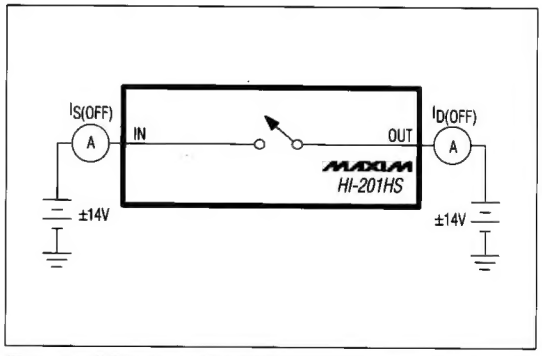


Figure 4. Off Leakage Current

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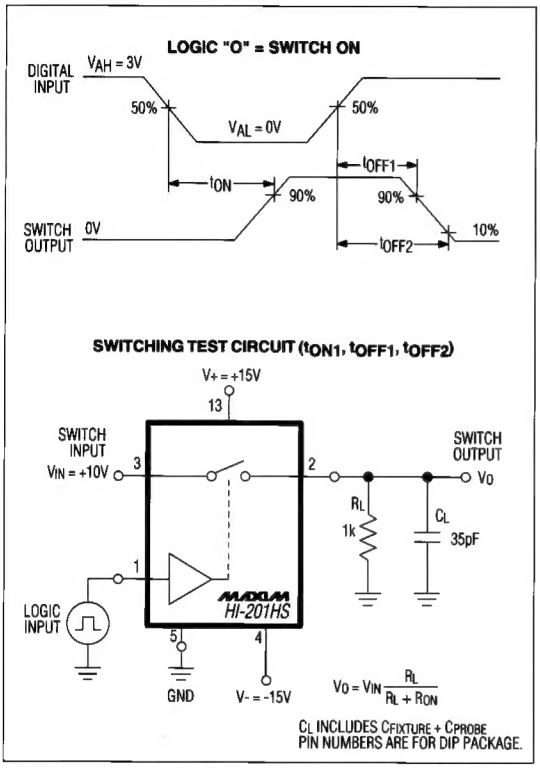
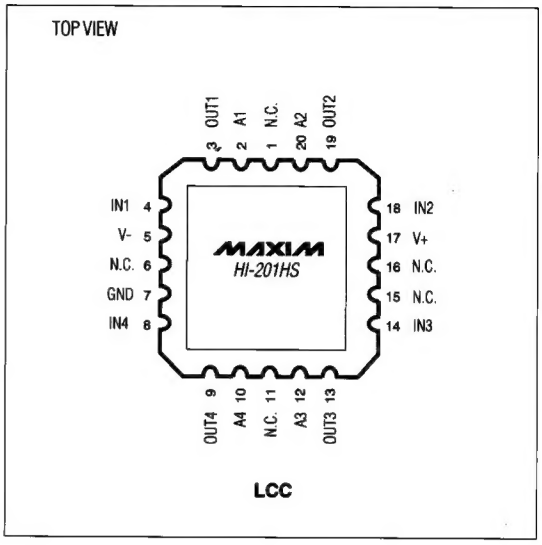
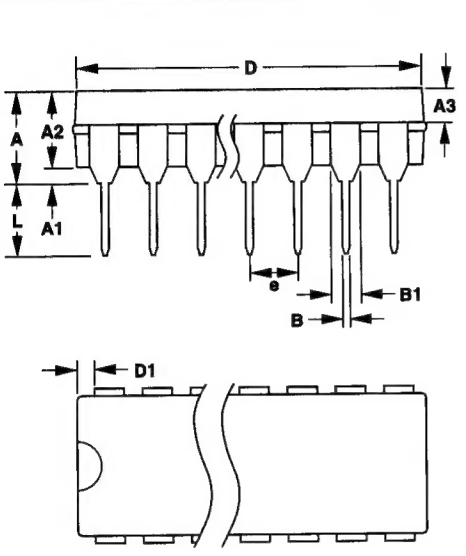


Figure 6. Switching-Time Test Circuit

Pin Configurations (continued)



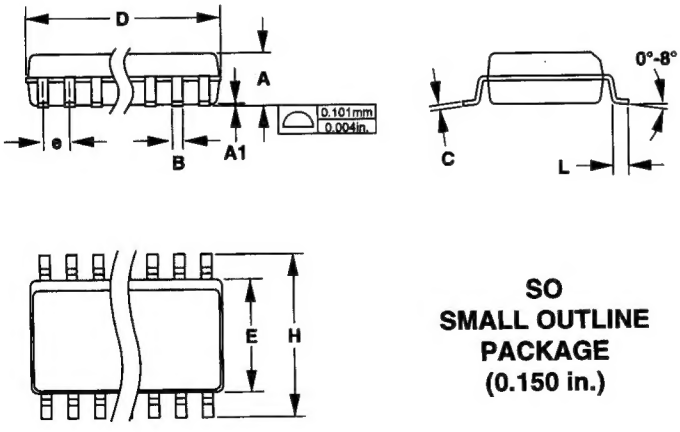
Package Information



Plastic DIP
PLASTIC
DUAL-IN-LINE
PACKAGE
(0.300 in.)

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	–	0.200	–	5.08
A1	0.015	–	0.38	–
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.016	0.022	0.41	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.012	0.20	0.30
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.26
E1	0.240	0.310	6.10	7.87
e	0.100	–	2.54	–
eA	0.300	–	7.62	–
eB	–	0.400	–	10.16
L	0.115	0.150	2.92	3.81

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	8	0.348	0.390	8.84	9.91
D	14	0.735	0.765	18.67	19.43
D	16	0.745	0.765	18.92	19.43
D	18	0.885	0.915	22.48	23.24
D	20	1.015	1.045	25.78	26.54
D	24	1.14	1.265	28.96	32.13



SO
SMALL OUTLINE
PACKAGE
(0.150 in.)

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
E	0.150	0.157	3.80	4.00
e	0.050		1.27	
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	8	0.189	0.197	4.80	5.00
D	14	0.337	0.344	8.55	8.75
D	16	0.386	0.394	9.80	10.00

21-0041A

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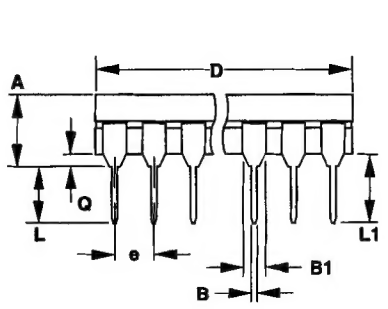
Package Information (continued)



CERDIP
CERAMIC DUAL-IN-LINE
PACKAGE
(0.300 in.)

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	–	0.200	–	5.08
B	0.014	0.023	0.36	0.58
B1	0.038	0.065	0.97	1.65
C	0.008	0.015	0.20	0.38
E	0.220	0.310	5.59	7.87
E1	0.290	0.320	7.37	8.13
e	0.100		2.54	
L	0.125	0.200	3.18	5.08
L1	0.150	–	3.81	–
Q	0.015	0.070	0.38	1.78
S	–	0.098	–	2.49
S1	0.005	–	0.13	–

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	8	–	0.405	–	10.29
D	14	–	0.785	–	19.94
D	16	–	0.840	–	21.34
D	18	–	0.960	–	24.38
D	20	–	1.060	–	26.92
D	24	–	1.280	–	32.51